

Light emission and lasing with anisotropic materials

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In most light emitting materials, photons are generated by an electrical dipole transition. Similar to a classical radio-antenna, the orientation of the electrical dipole determines the distribution of the emitted photons. Defining the orientation of the dipole emitters is important for many kinds of applications (displays, fluorescent solar concentrators, lasers). We investigated how long or disc-like organic dye molecules can be oriented by mixing them in a liquid crystal or by evaporating them into a thin organic film. The anisotropy of the host is used to orient the dye molecules but at the same time modifies the dipole emission. To analyze this problem, we developed a simulation tool [1] to calculate the emission from elementary electrical dipole emitters in an (inhomogeneous) anisotropic host. Chiral nematic liquid crystals self-organize into a periodic helical structure that has a strong influence on the photoluminescent properties of oriented dyes [2].

When the intensity of the emission is sufficiently high, stimulated emission and lasing can take over. Lasing in chiral nematic liquid crystal shows a lot of promise [3] and the threshold and emission wavelength can now be simulated [4]. Liquid crystal can also be used to tune the polarization of lasers, as has recently been demonstrated for VCSELS [5].

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